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Nutritional condition and gastrointestinal symptoms in patients with systemic sclerosis

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Systemic sclerosis (scleroderma/SSc) is a rare, connective autoimmune multisystem disease with wide-reaching consequences. SSc is recognized by the presence of serum autoantibodies and fibroproliferative changes in the microvasculature which, in turn, results in too much accumulation of collagen fibers in the skin and internal organs. Gastrointestinal (GI) involvement is highly prevalent among SSc patients (seen in over 90% of cases). Altered GI function and subsequent nutritional disorders are common outcomes of SSc, affecting the quality of life (QoL) and possibly carrying an associated rate of morbidity and mortality. Disease-related malnourishment is also considered to have a detrimental effect on clinical outcomes. There is little information on dietary advice for SSc patients, and as GI complaints are risk factors for bad nutritional status, perceptive assessment seems to be necessary. As the SSc pathogenesis is yet to be explored, recent investigations have aimed to evaluate the effect of diet in terms of triggering or altering the course of the disease. The present review aimed to discuss current knowledge relating to the effect of nutrition on SSc pathogenesis.

Keywords: Diet, Gastrointestinal involvement, Nutrition, Scleroderma, Systemic sclerosis

Introduction

Systemic sclerosis (scleroderma/SSc) is a fibrotic nature autoimmune disease with remarkable heterogeneity in organ involvement, clinical picture, course of the disease, laboratory and serological findings, complications, and prognosis [1]. A permissive genetic makeup, female gender, and exposure to environmental signals are considered as risk factors; however, the exact etiology of this disease is still unknown [2].

Vascular abnormalities, inflammation, immune dysfunction, and the production of specific autoantibodies are characteristic of SSc. The most hallmark feature of this complex connective tissue disorder (CTD) is a progressive fibrosis affecting the skin as well as numerous inner organs [3]. The prevalence and incidence of this rare disease in the USA is about 276 persons per million and 20 new cases per million per year, respectively [4]. The incidence and prevalence rates of SSc worldwide are estimated to be 13 and 200 subjects per 1 million individuals per year, respectively [2].

According to the phenotype of cutaneous manifestation, SSc is divided into two major subtypes: limited cutaneous (lcSSc) and diffuse cutaneous (dcSSc). In lcSSc form, which has minimal systemic involvement, the thickening of the skin develops later in life and is confined to the distal section of upper and lower extremities, face, neck, and upper chest. In contrast, in dcSSc, the pattern of skin hardening occurs early and spreads to the proximal part of the extremities and trunk [5]. Raynaud's phenomenon (RP) in dcSSc has an early onset and is usually represented within 1 year of onset of skin changes, while in the lcSSc category it occurs many years prior to skin involvement [6].

Significant organ involvement is often related to decreased survival rate in SSc subjects. Pulmonary fibrosis [interstitial lung disease (ILD)], digital ulceration, cardiac manifestation, pulmonary arterial hypertension (PAH), and renal manifestations are the most serious complications that may develop among SSc individuals [7, 8]. Gastrointestinal tract (GIT) involvement, including esophageal, gastric, small intestine, and colonic complications, affects about 90% of SSc patients [9]. In lcSSc patients, esophageal dysmotility is more frequent than small and large bowel involvement, whereas esophageal dysmotility is

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commonly observed and small and large intestinal complaints are more common in dcSSc patients [5].

The nutritional status and food intake of SSc subjects are interesting, as malnutrition is seen in up to 56% of patients [10]. Some SSc patients may experience malabsorption that could be a result of fibrosis in the GIT [11]. The significance of dietary and lifestyle modification habits in handling GI signs has been emphasized in a variety of clinical practice recommendations and literature data. These range from gaining supplemental calories, changing the amount of fiber consumption, probiotics, the intake of vitamin supplementation, or changing the timing, number, extent, or structure of meals. For this issue, specific exclusion and inclusion of special food stuffs may be considered as dietary advice for patients to increase their chances for optimized nutritional treatment [12-14].

How dietary modifications may alleviate the signs of uncomfortable GI symptoms is a usual question that many affected individuals ask their healthcare practitioners-/scleroderma experts. Because malnutrition affects the rate of disease morbidity and mortality, the evaluation of SSc-related nutritional risks in subjects can develop important insights for the design of more efficient interventional approaches. The present literature intended to investigate the beneficial role of nutritional diet and its association with SSc-related GI involvement and to provide certain information for daily practice.

SSc and GI involvement

Apart from the known disturbances, approximately 90% of SSc patients develop GI involvement related to their disease; however, intense GI complaints may be responsible for increased risk of morbidity and mortality outcomes in around 8% of patients [15]. GI disorders in SSc are related to altered smooth muscle function throughout the GIT with the presence of both myogenic and neural abnormalities [16]. Any level of the digestive tract from mouth to anus can be affected. Following GI involvement, patients may suffer from manifestations such as pain, dysmotility, small intestinal bacterial overgrowth (SIBO), body weight loss, malabsorption, GI reflux disease, as well as pseudo-obstruction (another SIBO risk factor) [17-19]. According to a report by EULAR Scleroderma Trials and Research (EUSTAR) database

, the pre-valence of intestinal involvement in SSc is about 23%, and no difference was observed between dcSSc and lcSSc subtypes. Special tests, however, represented the involve-ment of the small intestine as being in up to 88% of subjects [20]. Lower esophageal sphincter dysfunction and motility disorders of the GIT are the usual characteristics that may bring about early satiety, heartburn, regurgitation, and persistent nausea and vomiting [21].

Hypomotility leads to luminal meal/liquid stasis, which permits upstream SIBO. There is a correlation between SIBO, bile acid deconjugation, and fat malabsorption. Indeed, bacteria are capable of deconjugating bile acids, which promote fat digestion and absorption by forming micelles. Therefore, the deconjugation of bile salts by bacteria could be responsible for the malabsorption of various nutrients, e.g., fat and liposoluble vitamins [22, 23]. Bacterial overgrowth in the intestine may be observed through a bile acid deconjugation test. The malabsorption and steatorrhea in patients may be attributed to small intestinal stasis followed by bacterial overgrowth or to diminished intestinal permeability owing to intestinal fibrosis [24].

Smooth muscle atrophy and fibrosis within the GIT lead to sphincter perturbation (gastroesophageal reflux disease [GERD/GORD] and anorectal dysfunction) and delayed GI transit (dysphagia, SIBO, gastroparesis, and constipation) [25]. Because of esophageal impairment in SSc, patients may experience abnormal peristalsis and decreased lower esophageal sphincter pressure [26].

Szamosi undertook a study on a Hungarian population, including 40 males and 206 females. Esophageal involvement, including aperistalsis, GERD, pseudodiverticuli, etc., was more frequent (62.6%). Furthermore, stomach-related diseases (31.7%), colon- and anorectum-associated malfunctions (11.4%), biliary tract sclerosis, and other pancreato-biliary disorders (9.8%) were also observed [27].

Akesson et al. conducted an experiment including 24 patients with progressive SSc. GERD was indicated in 12 persons, elevation of gastric acid secretion in 13 (54%) subjects, and 4 patients demonstrated increased bile acid deconjugation [24]. Table 1 shows the frequency of gastrointestinal complaints in SSc patients in previously published papers.

Table 1. Frequency of gastrointestinal complaints in SSc patients in previously published papers

Gastrointestinal complaints	N (%)		
Anorexia	ND	ND	19 (11.9)
Dysphagia	ND	ND	68 (42.5)
Nausea	86 (14.68)	4 (7.1%)*	24 (15.0)
Vomiting	ND	ND	17 (10.6)
Regurgitation	ND	ND	58 (36.3)
Early satiation	235 (40.10)	9 (16.1%)	18 (11.3)

Gastrointestinal complaints	N (%)		
Constipation	156 (26.62)	11 (19.6%)	51 (31.9)
Poor appetite	170 (29.01)	12 (21.4%)	ND
Difficulty swallowing	316 (53.92)	14 (25.0%)	ND
Reflux symptoms	377 (64.33)	ND	34 (21.2)
Abdomen swelling or bloating	219 (37.37)	13 (23.2%)	17 (10.6)
Diarrhea	129 (22.01)	5 (8.9%)	38 (23.8)
Steatorrhea	113 (19.28)	2 (3.6%)	ND
Fecal incontinence	109 (18.60)	1 (1.8%)	ND
Author	Murray Baron	Anna Wojteczek	Roberto Caporali
N	586	56	160
Year	2009	2019	2012
Reference	[31]	[33]	[43]

Nutritional screening

Patients diagnosed as being at risk for malnutrition through any modality require suitable dietetic evaluation and modification. Early recognition of the signs of malnutrition in patients with SSc has great importance in providing the necessary specialized care [28]. Therefore, screening SSc individuals with GI difficulties and malnutrition may be a good predictor of SSc-associated mortality [29].

A single body mass index (BMI) value and serum proteins such as albumin (a negative active-phase reactant) as traditional markers of nutritional status do not appear to be good indicators of SSc-associated malnutrition [11, 30]. For this reason, diverse screening tools for diagnosing malnutrition have been developed.

One of the screening tools for identifying malnutrition risk in adults is the “malnutrition universal screening tool” (MUST), produced by the British Association for Parenteral and Enteral Nutrition (BAPEN) [31]. MUST is established on 3 clinical parameters, which are associated with poor consequences: BMI, percentage unplanned weight loss (WL) in the preceding 3 to 6 months, and decreased food intake for more than 5 days [32].

In 2015, an effective criterion for malnutrition rate was proposed by the European Society for Parenteral and Enteral Nutrition (ESPEN), and in 2018 its modified version as the Global Leadership Initiative on Malnutrition (GLIM) criteria was offered. Nutritional status could be assayed using the Subjective Global Assessment (1-7 points) (7-SGA) and Short Nutritional Assessment Questionnaire (SNAQ) [33].

Bioelectrical impedance analysis (BIA) is a rapid and safe method that estimates body composition, in particular body fat and lean muscle, and calculates resistance (R) and reactance (Xc), which allows the measurement of phase angle (PhA). PhA is an important parameter representing the relationship between hydration status and nutrition. It is also an indicator of cellular health and integrity [32]. In the state of disease conditions, such as inflammation, infection, and chronic disorders, PhA is frequently lower than normal [34]. Krause et al. studied 124 patients with SSc and concluded that PhA can be used as a marker for both nutritional status and disease severity in the disease. They also reported that PhA was lower in SSc patients than in gender, age, and BMI-matched controls [11]. In a survey by Stobaeus et al., inflammation and malnutrition were recognized as significant predictors of reduction in PhA [35].

A North American panel of experts recommended obtaining a set of laboratory tests for SSc-related malnutrition, consisting of serum hemoglobin level, folic acid, and serum carotene levels [29]. Table 2 presents the main findings of previously published papers on malnutrition in SSc.

Table 2. The main findings of the previously published papers on malnutrition in SSc

Author	N	Year	Nationality	Criteria to define malnutrition and prevalence of malnutrition				Reference
Anna Wojteczek,	56	2019	Polish	Impaired nutritional status: 16.1% in SNAQ	Impaired nutritional status: 17.9% according to ESPEN 2015 criteria	Impaired nutritional status: 23.2% in 7-SGA	Impaired nutritional status: 62.5% using GLIM criteria	[33]
Murray Baron	586	2009	Canadian	--	Medium risk for malnutrition: 10.8% using MUST score	High risk for malnutrition: 17.4% using MUST score	--	[31]
İpek Türk,	98	2019	Turkish	Low risk for malnutrition: 61.2% using MUST score	Medium risk for malnutrition: 15.3% using MUST score	High risk for malnutrition: 23.5% using MUST score	--	[26]
Cristian Caimmi	141	2017	Italian	Low risk for malnutrition: 79.4% using MUST score	Medium risk for malnutrition: 12.8% using MUST score	High risk for malnutrition: 7.8% using MUST score	Prevalence of malnutrition according to ESPEN 2015 criteria: 9.2%	[40]
Aysa César Pinheiro	71	2019	Brazilian	Low risk for malnutrition: 75% using MUST score	Medium risk for malnutrition: 8% using MUST score	High risk for malnutrition: 17% using MUST score	--	[42]
Maureen A. Murtaugh	24	2012	USA	Low risk for malnutrition:15 patient using MUST score	Medium risk for malnutrition:2 patient using MUST score	High risk for malnutrition:7 patient using MUST score	Moderate to severe malnutrition:12 patient using SGA	[10]
Emelina Preis	129	2018	Germany	--	Medium risk of malnutrition (MUST score= 1): 14.7%	High risk of malnutrition (MUST score ≥ 2): 10.9%	--	[44]
Emanuele Cereda	160	2013	Italian	Low risk for malnutrition (MUST= 1): 30%	--	High risk for malnutrition (MUST score ≥2): 24.4%	--	[45]

Nutritional status and disease activity and severity

It is widely believed that SSc patients with GI complaints are at risk for malnutrition [21]. Malnutrition has been described as "a state of nutrition in which a deficiency, excess, or imbalance of energy, protein, and other nutrients results in measurable adverse effects on tissue/body form (body shape, size, composition) and function and clinical outcome" [36]. Malnutrition adversely affects quality of life (QoL) and may be accompanied by a varying set of morbidity and mortality [37]. In past decades (1972-1977), malnutrition was introduced as accounting for 12% of SSc-related deaths; however, with the improvement in nutritional supports, the number of malnutrition-related deaths has fallen [37]. In SSc patients, esophageal, microstomia, and bowel involvement results in complications with eating and the absorption of nutrients [3]. In addition, clinical manifestations including respiratory dysfunction, depression, inflammation, and muscle weakness lead to malnutrition, which may be considered an independent risk factor for mortality [28, 37]. In some patients, malnutrition may be correlated with malabsorption of different nutrients secondary to bacterial overgrowth [38]. Furthermore, altered intestinal microbiota in SSc can be associated with an increased risk of malnutrition [20].

In a study by Wojteczek et al., rates of malnutrition in SSc patients were assessed using different screening tools. They assessed nutritional status in 47 females and 9 males with SSc using 7-SGA and SNAQ. GI disturbances were exhibited in 76.8% of respondents, and a BMI of less than 18.5 was observed in 5.4% of patients. The percentage of subjects with the evidence of impaired nutritional status

was higher and different, depending on the tools used: about 17.9% according to ESPEN 2015, 16.1% in SNAQ, 23.2% in 7-SGA, and as high as 62.5% based on GLIM criteria [33].

In 2009, Baron et al. performed a large cross-sectional, multicenter study consisting of 586 SSc individuals from the Canadian Scleroderma Research Group Registry (CSRG). Considering MUST scores, almost 18% and 10.8% of SSc patients were at high risk and medium risk for malnutrition, respectively. They concluded that SSc subjects have a moderate risk for malnutrition that is associated with shorter disease duration, signs of GI involvement, and physician global assessment of disease severity. Of note, no apparent associations were observed between reflux or dysphagia and malnutrition risk. Based on their findings, a significant association was represented between early satiety and malnutrition risk [31].

An investigation by Lundberg et al. in 1992 included 30 SSc patients with GI symptoms (17 dcSSc, 13 lcSSc) and healthy matched controls. This study demonstrated no differences in the amount of energy intake (8-1 and 8-4 MJ/day) and its distribution among different nutrients in patients in comparison to the control group; however, a lower intake of dietary fiber, fruits, and vegetables among SSc patients was observed [39].

In 2020, Turk et al. conducted a study on 98 SSc patients. According to the MUST scores, 61.2% of patients were at low risk, 15.3% were at medium risk, and 23.5% were at high risk for malnutrition. Malnutrition risk was correlated with ILD (*p value* = 0.044) and bowel involvement (*p value* = 0.021) and was higher in SSc individuals with mild-to-severe depressive symptoms compared to those without (*p value* = 0.012) [26].

In 2017, a survey of 141 patients was performed by Caimmi et al. According to the MUST screening tool, 18 (12.8%) of SSc subjects were at moderate and 11 (7.8%) were at high risk for malnutrition, and the prevalence of malnutrition defined by 2015 ESPEN criteria was 9.2% (95% CI, 4.4–14.0%) [40]. Patients with malnutrition had longer disease duration (p=0.019) and worse disease severity according to Medsger severity score ($p < 0.001$) [40].

Pinheiro et al. evaluated 71 patients with SSc and applied the Scleroderma Health Assessment Questionnaire (SHAQ) to assess disability [41]. Approximately 17%, 8%, and 75% of the patients presented with high, moderate, and low nutritional risk, respectively. In patients without myopathy, the moderate/high nutritional risk was found to be higher (76%) compared to those with myopathy (20%), and this difference was statistically significant (p=0.001) [42].

Murtaugh et al. used Must score in their trial, and 9 patients out of 24 (21 lcSSc, 4 dcSSc) were at moderate to high risk for malnutrition. Furthermore, 12 patients with moderate to severe malnutrition were assessed using the SGA [10].

In a report by Caporali et al. on 186 SSc subjects (87.5% females), the prevalence of malnutrition (defined by BMI <20 kg/m^2 and/or preceding 6-month unintentional weight loss ≥10%) was 15% (95%, CI 10-21). The association between malnutrition and GI abnormalities was not statistically significant. They introduced serum prealbumin (transthyretin), a visceral protein, as an early indicator of malnutrition in SSc. Malnourished SSc individuals presented a higher median score, which was significant ($p < 0.001$) for disease activity [43].

In a trial conducted by Preis et al., which included 129 SSc patients, the prevalence of malnutrition was 10.9% and an association between reduced QoL and severe malnourishment was observed in SSc patients [44].

Cereda et al. undertook a study involving 160 SSc outpatients to assess the relationship between mortality and nutritional risk in SSc patients. They reported the prevalence of high nutritional risk (MUST score ≥ 2) to be around 24.4% and concluded that MUST significantly predicted mortality in SSc patients [45].

Krause et al. conducted a survey with 124 consecutive Caucasian cases with SSc and 295 healthy individuals. The results showed that 69 (55.7%) SSc patients had malnutrition that was associated with severe disease and disease activity. In their literature, BIA parameters represented disease severity and were the best predictors for patient survival [11].

In 2017, Cruz-Dominguez et al. performed a cohort study on 220 Mexican SSc patients. They reported that infections, cardiovascular disorders, and lung involvement were the leading causes of death. In addition, they reported malnutrition as a crucial and independent risk factor for mortality in SSc patients [28].

In a survey by Ortiz-Santamaria, vitamin D deficiency and anemia associated with iron deficiency were the most frequently reported nutritional deficits, assessed at about 54% and 18.35%, respectively [46].

Overall, survival surveys in SSc reflect different results, dependent upon patient demographic features, disease classification, and pattern of organ system involvement, and are thus difficult to compare. Another reason that comparisons are difficult to make is the differences in the proportions of subjects with lcSSc and dcSSc, and in the frequency of serum autoantibodies, such as anti-centromere antibodies (ACA) and anti-scleroderma 70 antibody (Anti-Scl70), in various ethnic populations [47].

Malnutrition related to SSc conditions

Depression is a psychological problem that can develop in SSc patients and may bring about a decline in appetite and food intake. In a SSc survey by Thombs et al., patients reported higher frequencies of appetite loss in comparison with a matched control group on the total score of the Center for Epidemiologic Studies Depression Scale (CES-D) [48].

As a consequence of perioral soft tissue fibrosis, microstomia may be present in patients with SSc [49]. It is evident that diminished oral aperture and/or dry mouth is associated with reduced oral intake and poor oral hygiene, leading to malnutrition in these patients [26] [31]. Patients with

hand diseases such as digital ulcers may experience impairment in daily activities, including meal preparation and eating [37].

Xerostomia predisposes a patient to oral pathogens, which, in association with trivial hand dexterity, may delay effective dental hygiene. This increases the risk of dental caries and tooth loss, chewing problems, damaging mastication, changing meal choice, and subsequently leads to nutritional decline [37].

Furthermore, SSc patients may suffer from overlapping with autoimmune Sicca or Sjögren's syndrome, which in turn can aggravate the swallowing process [50]. Swallowing problems may influence patients' QoL, cause them to tend to hazardous coping strategies (splitting or crushing pills), and cause poor adherence to medication regimens [50].

Nutrient recommendations

Currently, there's no cure for SSc; therefore, providing psychological support, educational and behavioral interventions, appropriate dietetic assessment, and more specialized physical therapy are of crucial value to the management of the disease and to preventing additional complications [50].

For difficulties in swallowing dry foods and liquids, i.e. dysphagia, patients are recommended to chew and eat food slowly, eat smaller amounts, and take more frequent meals (every three to four hours). Another recommendation is to avoid consumption of sticky foods, such as boiled rice, mashed potatoes, grilled meat, sliced bread, artichokes, and asparagus. Patients' intake of dry foods such as nuts and toast should also be minimized. Another dietary recommendation for patients is not to forget to drink fresh-/filtered water or other liquids between bites to help swallowing [51].

In severe conditions such as SSc-related intestinal failure where the patient is incapable of maintaining his/her nutrition in a stable manner, parenteral nutrition (PN) may be required to prevent or correct malnutrition [38]. A low-fat diet, medium-chain triglycerides (MCT), as well as avoidance of lactulose and fructose are examples of diet modifications advised for the management of diarrhea in SSc patients [20].

Contrary to the advice that a high fiber diet is "good for all", results from a small case series by Gough et al. in 1998 suggest that a high fiber diet may actually aggravate GI symptoms in SSc patients. In their report, 3 out of 4 cases required emergency admission after receiving such advice. They reported that loading the bowel with dietary fiber can lead to acutely problems [52].

When symptoms are mild, alterations in lifestyle must be taken into account. Some general, pragmatic approaches include avoiding consumption of large meals or dry or fatty foods, not eating a certain number of hours before bedtime, chewing food well, raising the head from the bed, taking multiple small meals, stopping smoking, taking plenty of water with solid foods, and remaining upright for 3 to 4 hours after eating [9, 25].

Tooth caries and tooth loss are associated with poor nutrition; regular visits with a dentist may be beneficial for good oral health [37]. SSc patients who have the symptoms of psychological problems (such as depressive symptoms) during screening should be referred to a psychiatric technician [26].

It has become routine for clinical practice guidelines to point out a more broad range of specific recommendations on dietary modification in managing the nutritional status of SSc patients. For example, in a logical consultation with the assumption that there are no other medical contra-indications, patients should be encouraged to have a mixed balanced diet containing both macro- and micronutrients. A low-fat diet, supplementation of MCT, avoidance of foods containing fructose and lactose, and intake of stool bulking agents are other interventions that are administered to the patients with intestinal manifestation [21, 20].

Discussion

Systemic sclerosis is a multisystem disorder which develops the overproduction of collagen. This chronic autoimmune disease does not have a defined nature. Unfortunately, SSc shows signs of being an incurable disorder with limited impressive pharmacologic approaches designed to treat symptoms [53]. The progress of the disese is controversial; in some patients with SSc, the disease progresses rapidly and affects critical organs, resulting in death secondary to cardiac, pulmonary, or renal failure. In other patients, the disease remains in a relatively benign condition, and the patient is stable for a long period of time [54].

SSc may involve whole segments of the GIT. Histopathological experiments have shown diffuse fibrosis of the colon with atrophy of the smooth muscle layers as the prominent feature of this disease. Therefore, constipation or infrequent bowel movements are usual complaints [52]. Possible GI-related complaints such as reflux, bloating or fecal incontinence, which sometimes are troublesome, may, in turn, impact QoL, and sadly, are very common in SSc patients [10, 55, 56]. In SSc, multiple associated gastrointestinal complications, including bacterial overgrowth, decreased intestinal function with dysmotility, reduced pancreatic activity, and malabsorption of fat, bile acids, and other nutrients may result in diminished nutrient uptake, reduced caloric intake, and increased nutrient losses [39]. In general, patients with evidence of GI problems are considered to have a low QoL, which is further exacerbated when patients are malnourished [57].

There is little information about the nutritional status of SSc patients, and the treatment of SSc is challenging. It has been proposed that nutritional support may help prevent progressive debilitation in SSc, and nutritional strategies may impact QoL and survival rates [10]. Considerable evidence from studies supports a high prevalence of malnutrition in SSc patients and its destructive impact on prognosis [10, 31, 40, 44]. The different prevalence rates of malnutrition, ranging between 5.3% [58] and 55.6% [11], observed in various investigations may be ascribed to the use of different criteria to define malnutrition [40]. SSc-

associated parameters may promote the increased risk of malnutrition, including shorter length of the disease, GI involvement, disease severity, the extent of cutaneous involvement, and the presence of microstomia [26, 31]. Moreover, patients with SSc who suffer from mood disorders such as depression, anxiety, or fatigue may experience decreased appetite and food intake [44].

The question of whether nutritional supports represent disease severity and can predict disease progression or mortality remains unanswered [11]. The investigation of the correlation between disease severity and risk of malnutrition revealed discrepancies. Baron et al. observed that physicians global assessment of disease severity was higher in malnourished patients [31], whereas the results of the study by Caporali et al. showed no differences [43]. Caimmi et al. reported that disease severity may impair nutritional status [40]. A correlation between lung involvement and malnutrition was also found in the investigation by Caimmi et al [40]. Apposite findings were found in the association between disease type (dcSSc/lcSSc) and malnutrition. A study reported significantly higher MUST scores in the dcSSc subset [31], whereas no significant association was demonstrated between disease type and malnutrition in other investigations [43] [40] [44]. The rate of mortality due to significant malnutrition has been reported to be around 20%, and it is higher in comparison with cases with nutritional sufficiency [59].

At present, a group of specialists, including a rheumatologist, a nutritionist, and a gastroenterologist, is needed to monitor and manage SSc patients with malnutrition and complicated GI disease [29]. It is noteworthy that malnutrition is not only limited to GI involvement; it could be secondary to a chronic inflammatory background in the systemic disease [60]. It is also noteworthy that nutritional support may not improve the natural history of SSc, but it is possible to prevent progressive debilitation due to nutritional depletion [39]. The development of specialist knowledge and the choice of an appropriate diagnostic tool for monitoring and screening GI involvement and nutritional status in SSc patients may be favorable for preventing the development of severe conditions in these patients [33].

Conclusion

Systemic sclerosis is a systemic disease, and predicting consequences for an affected individual remains a challenge because of the heterogeneous nature of the disease in its progression in critical internal organs. In particular, GI pathology is detected in a huge number of SSc patients. Multiple functions of the GIT can be affected by SSc manifestation, which collectively results in impairment of motility, digestion, absorption, and excretion [53]. Nutritional therapeutic approaches have an impact on QoL and survival rate. Currently, we are unable to draw absolute conc-lusions about the effectiveness of improvements in dietary habits, because the data is confined to a low number of small studies. To shed light on this issue, future clinical practice guidelines should provide ideal approaches to such interventions in the management of SSc-related GI involvement.

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None.

Conflict of interest

None.

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